CLAIMS

What is claimed is:

1. An electrically conductive flow field separator plate for use in a proton exchange membrane fuel cell, comprising a frame portion, a central planar portion within the frame portion and a flow field formed in a surface of the central planar portion, wherein the frame portion is elastomeric so as to be capable of forming a seal with adjacent fuel cell components thereby eliminating the use of separate sealing elements.

2. The electrically conductive flow field separator plate of claim 1, wherein the central planar portion is elastomeric.

3. The electrically conductive flow field separator plate of claims 1 or 2, wherein the frame portion and the central planar portion are either of different or of unitary construction, and the frame portion and optionally the central planar portion comprising:

   (a) from about 10 wt% to about 50 wt% of elastomer and from about 50 wt% to about 90 wt% of conductive filler, based on the total amount of elastomer and filler; and

   (b) an effective amount of a cross-linking agent.

4. The electrically conductive flow field separator plate of claims 1 or 2, wherein the frame portion and the central planar portion are of unitary construction, comprising:

   (a) from about 15 wt% to about 30 wt% of elastomer and from about 70 wt% to about 85 wt% of conductive filler, based on the total amount of elastomer and filler; and

   (b) an effective amount of a cross-linking agent.

5. The electrically conductive flow field separator plate of claims 3 or 4 comprising from about 0.1 to about 10 parts by weight, based on 100 parts by weight of the elastomer, of the cross-linking agent.

6. The electrically conductive flow field separator plate of claims 3 or 4 comprising from about 0.1 to about 5 parts by weight, based on 100 parts by weight of the elastomer, of the cross-linking agent.

7. The electrically conductive flow field separator plate of any one of claims 3 to 6 further comprising from about 0.1 to 20 parts by weight, based on 100 parts by weight of the elastomer, of one or more additives selected from the group consisting of acid acceptors, flame retardants, plastisizers, processing aids, vulcanizing agents and mixtures thereof.

8. The electrically conductive flow field separator plate of any one of claims 3 to 7, wherein the elastomer is selected from the group consisting of crosslinkable thermoplastic elastomers, chlorinated elastomers, fluorinated elastomers, silicone elastomers, EPDM rubbers, natural butyl rubbers and mixtures thereof.

9. The electrically conductive flow field separator plate of any one of claims 3 to 7, wherein the conductive filler is selected from the group consisting of conductive graphite powders, graphite fibres, carbon black, carbon fibres, conductive ceramic fillers, metal fillers metal-coated fillers, inherent conductive polymers and mixtures thereof.

10. The electrically conductive flow field separator plate of any one of claims 3 to 7 wherein the elastomer is a chlorinated elastomer and the conductive filler is selected from graphite powders, graphite fibres and mixtures thereof.

11. The electrically conductive flow field separator plate of any one of claims 1-10 comprising flow fields on both surfaces of the central planar portion.

12. The electrically conductive flow field separator plate of any one of claims 1-11 having a bulk resistivity of less than 10 ohm-cm.

13. A method of making an electrically conductive flow field separator plate for use in a proton exchange membrane fuel cell, wherein the plate comprises a frame portion, a central planar portion within the frame portion and a flow field formed in a surface of the central planar portion, the method comprising:

(a) mixing from about 10 wt% to about 50 wt% of elastomer and from about 50 wt% to about 90 wt% of conductive filler, based on the total amount of elastomer and filler, and an effective amount of a cross-linking agent to form a blend; and

(b) molding the blend by applying sufficient heat and pressure to form the plate,

wherein the frame portion is elastomeric so as to be capable of forming a seal with adjacent fuel cell components thereby eliminating the use of separate sealing elements.

14. The method of claim 13, wherein in step (a), from about 15 wt% to about 30 wt% of elastomer; and from about 70 wt% to about 85 wt% of conductive filler, based on the total amount of elastomer and filler, are mixed to form the blend.

15. The method of claims 13 or 14 wherein about 0.1 to about 10 parts by weight, based on 100 parts by weight of the elastomer, of the cross-linking agent are mixed to form the blend.

16. The method of claims 13 or 14 wherein about 0.1 to about 5 parts by weight, based on 100 parts by weight of the elastomer, of the cross-linking agent are mixed to form the blend.

17. The method of any one of claims 13 to 16 wherein in step (a), from about 0.1 to 20 parts by weight, based on 100 parts by weight of the elastomer, of one or more additives selected from the group consisting of acid acceptors, flame retardants, plastisizers, processing aids, vulcanizing agents and mixtures thereof are mixed.

18. The method of any one of claims 13 to 17, wherein the elastomer is selected from the group consisting of crosslinkable thermoplastic elastomers, chlorinated elastomers, fluorinated elastomers, silicone elastomers, EPDM rubbers, natural butyl rubbers and mixtures thereof.

19. The method of any one of claims 13 to 17 wherein the conductive filler is selected from the group consisting of conductive graphite powders, graphite fibres, carbon black, carbon fibres, conductive ceramic fillers, metal fillers metal-coated fillers, inherent conductive polymers and mixtures thereof.

20. The method of any one of claims 13 to 17 wherein the elastomer is a chlorinated elastomer and the conductive filler is selected from graphite powders, graphite fibres and mixtures thereof.

21. The method of any one of claims 13-20 further comprising the step of forming a flow field on a surface the central planar portion.

22. The method of any one of claims 13-21 wherein the plate has a bulk resistivity of less than 10 ohm-cm.

23. The method of any one of claims 13-22, wherein step (a) is carried out at a mixing temperature of from about 20 to about 100°C for a mixing time of from about 0.1 to about 60 minutes.

24. The method of any one of claims 13-22, wherein step (a) is carried out at a mixing temperature of from about 40 to about 80°C for a mixing time of from about 0.5 to about 20 minutes.

25. The method of any one of claims 13-24, wherein step (b) is carried out at a molding temperature of from about 120 to about 200°C for a molding time of from about 0.1 to about 60 minutes.

26. The method of any one of claims 13-24, wherein step (b) is carried out at a molding temperature of from about 150 to about 180°C for a molding time of from about 5 to about 20 minutes.